MANAGEMENT OF UNSTABLE INTERTROCHANTERIC FRACTURES IN ELDERLY PATIENTS WITH CEMENTED BIPOLAR ARTHROPLASTY – A PROSPECTIVE STUDY

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M.S DEGREE IN ORTHOPAEDIC SURGERY

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CERTIFICATE

This is to certify that the dissertation entitled **"Management of Unstable Intertrochanteric Fractures In Elderly Patients with Cemented Bipolar Arthroplasty – A Prospective Study"** is a bonafide work done by **Dr. S.SENTHIL** in **M.S BRANCH II ORTHOPAEDIC SURGERY** at Government Mohan Kumaramangalam Medical College, Salem-636030, to be submitted to The Tamil Nadu Dr.M.G.R Medical University, in partial fulfilment of the University Rules and Regulation for the award of M.S. Degree Branch II Orthopaedic Surgery, under my supervision and guidance, during the academic period from May 2008 to April 2011.

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DECLARATION

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CONTENTS

INTRODUCTION

Intertrochanteric fractures is one of the most common fractures of the hip especially in the elderly with osteoporosis. It usually occurs due to low energy trauma like simple falls. The incidence of intertrochanteric fracture is rising because of number of increase in the senior citizens with osteoporosis. By 2040 the incidence is estimated to be doubled. In India the figure may be much more[1.] The incidence of trochanteric fractures is more in the female population compared to the male due to postmenopausal osteoporosis. Inspite of the advances in anesthesia, nursing care and the surgical techniques, hip fractures remain a significant cause of morbidity and mortality in the elderly population. Hip fractures are devastating injuries that most commonly affect the elderly and have a tremendous impact on both the health care system and society in general.[1]

Various methods of treatment have been employed since ages. But the problem remains an enigma unsolved till today.[1] The prolonged immobilization in elderly will jeopardize the life span of patient and further complicates the problem. This forces one to totally abandon the complete immobilization to achieve a bony union, and to resort early ambulatory procedures like DHS, IMN with SHS, and hemireplacement arthroplasty to achieve fair degree of function.

In the past, fixed nail plate devices used for fixation of these fractures had high rates of cut-out and fracture displacement. Subsequently a sliding hip screw was used with much success and became the predominant mode of fixation in these fractures. Complications such as head perforation, excessive sliding leading to shortening, plate pullout, and plate breakage continued to be a problem especially in unstable type of fractures. Osteoporosis and instability are one of the most important factors leading to unsatisfactory results. Also in these elderly patients with unstable osteoporotic fractures, a period of restricted mobilization suggested, which may cause complications like atelectasis, bed sores, pneumonia,and deep vein thrombosis.

Intramedullary interlocking devices have shown reduced tendency for cut-outs in osteoporotic bones, and also have better results in cases of unstable intertrochanteric fractures. However,the role of intramedulary devices in unstable intertrochanteric fractures is still to be defined. Thus fracture stability, bone strength, and early rehabilitation determined the final results in case of intertrochanteric fractures.

It is a known fact that the hip is a weight bearing joint and has to perform many functions. A successful operation at the hip joint should provide painless, stable hip with wide range of movements. But none of the accepted procedures for intertrochantric fractures have been able to achieve this goal fully. The patient also needs to go through in many instances, multiple surgical procedures and a prolonged rehabilitation in order to preserve his original joint.

Endoprosthetic replacements have also been shown to achieve early rehabilitation of these patients and good long-term results. Hemireplacement arthroplasty by using vitallium or stainless steel was popularly practiced by Austin Moore, produced fairly good results.[2,3] But it had its limitations in loosening and reactions at acetabulum etc. Many of the shortcomings of this procedure were overcome by a new type of prosthesis, which had the great advantage of second joint, below the acetabulum. It was named as bipolar prosthesis, since it had an outer head of metal which articulates with the acetabulum and a second inner small metallic head which articulates with the high density polyethylene (HDPE), lining the inner surface of the outer head. This prosthesis is very useful and results are encouraging.[4]

AIM OF THE STUDY

- To analyze the role of cemented bipolar arthroplasty in elderly patients with unstable intertrochanteric fractures.

- Assessment of functional outcome based on subjective parameters (like pain, ability to walk) and objective parameters (like deformity,range of movements of the hip and limb length).

REVIEW OF LITERATURE

Extensive literature search was carried out to review National and International studies on Prosthetic replacement in Intertrochanteric fracture in order to get a better understanding of the study designs, methodologies and the surgical procedures used.

EVOLUTION OF INTERTROCHANTERIC FRACTURES TREATMET

Till the third decade of the twentieth century trochanteric fractures were treated conservatively. Conservative treatment regimes included, simple support with pillows or splinting to the opposite limb, Buck's (skin) traction, well-leg traction, plaster spica immobilization, Russell's balanced traction and skeletal traction through the lower femur or upper tibia.

In 1916- **Heygroves**[5] introduced the quadriflanged nail, which was designed to obtain better fixation of the femoral head and prevent cutout

In 1931-**Smith-Peterson**[5] reported their series of open nailing with the triflanged nail. They advocated open reduction, impaction and internal fixation of the fracture.

In **1937-Lawson Thornton**[6] developed a plate to be attached to the Smith Peterson nail, called the **Thornton plate**. This was a breakthrough in the history of operative treatment of trochanteric fractures.

In **1944 -Capener Neufeld**[5] simplified the Jewett nail and introduced stainless steel one-piece angled plate called **V-plate**. In the same year, **Moore A.T.** designed a blade plate.[5]

In **1947-Mc Laughlin**[7] introduced the adjustable nail plate combination. He used triflanged nail with its lateral end having a slot to which a plate is fixed with a washer and bolt.[7]

In **1949-Merwyn Evans**[8] devised a classification dividing trochanteric fractures into stable and unstable types. He presented 101 cases treated conservatively and 22 cases treated by internal fixation with Capener Neufeld nail plates and suggested that internal fixation of trochanteric fractures has the advantages of early mobility of the patient and lowered mortality.

In **1950- Earnest Roll**[9] in Germany was the first to use a sliding device for internal fixation of trochanteric fractures.

In **1955-Pugh** and **Badgley**[10] introduced a sliding device with trephine tip in USA. In the same year, **Schumpelick**[11] described the use of a sliding nail device.

In **1957-Clawson**[12] studied both stable and unstable fractures internally fixed with a nail plate and found that 41% of the fractures go into varus, and he concluded that for the unstable fractures traction was better than internal fixation with a nail plate.

In **1959 -Cleveland**[13] reported an overall failure rate of 20% after fixation of 22 fractures with a Jewett nail plate.

In **1962- Massie**[14] modified the sliding nail plate device to allow collapse and impaction of the fragments, which lead to improved results in the treatment of trochanteric fractures.

In **1964- Clawson**[15] reported the treatment of trochanteric fractures using Sliding Compression Screw and Jewett nail. In 39 stable fractures treated with sliding screws there were only 5.2% failure rate. In the 26 unstable fractures treated with sliding screws there was a failure rate of 11.5%. In the fractures stabilized with jewett nail plate device, most of which were stable fractures failure rate was about 32%. The **Richards Manufacturing Company** and **Mr. Ian McKenzie** of the Royal National Orthopaedic Hospital developed the Sliding Compression Screw. Clawson made several modifications, and in its current form the device is known as the **Richards Compression Screw.**

In 1973-**Rosenfeld, Schwartz, and Alter**[16] reported good results with the use of the Leinbach prosthesis in intertrochateric fractures.

In 1974-The **Bipolar prosthesis** was first introduced by James. E. Bateman and Giliberty[17,] The commonly known versions of bipolar prosthesis are Monkduo pleet, Monk (1976), Hastings Bipolar prosthesis[18,19], Modular Bipolar prosthesis (Biotechnic france) and Talwalkar's Bipolar endoprosthesis[20] (Inor, India).

In1974-**Tronzo** [21] claimed to be the first to use long, straight-stemmed prosthesis for the primary treatment of intertrochanteric fractures.

In 1987- **Green S, Moore T, Proana F**[22] reported 75%to 95% outcome in elderly patients treated with bipolar hemi arthroplasty for intertrochanteric fractures.

In 2002-**rodop et al**[23] in a study of primary bipolar hemiprosthesis for unstable intertrochanteric fractures in 37 elderly patients obtained 17 excellent (45%) and 14 good (37%) results after 12 months according to the Harris hip-scoring system.

In 2005- **Liang et al**[24] in their study of unstable intertrochanteric fractures concluded hemiprosthesis arthroplasty is an effective method to treat the unstable intertrochanteric fractures in elderly.

In 2005-**Grimsrud et al**[25] used a standard cemented femoral component and reconstructed the fractured metaphyseal bone fragments and greater trochanter with a novel cabling technique.

In 2006-**Kayali et al**[26] compared the functional outcomes of unstable intertrochanteric fractures treated with internal fixation or cone hemiarthroplasty at a mean follow-up period of 24 months . Their results showed that, whereas clinical outcomes were similar for the two groups, hemiarthroplasty had a lower postoperative complication rate and earlier weight bearing.

In 2010-**sanchetti et al**[27] in their study, a total of 32 out of 35 patients (91%) treated with cemented bipolar replacement for elderly unstable osteoporotic intertrochantaric fracture had excellent to fair functional results (mean 84.8±9.72, range 58-97).

ANATOMY OF THE HIP JOINT

The hip joint is a multi axial ball and socket joint . The femoral head articulates with the cup shaped acetabulum.[28] The articular surfaces are reciprocally curved and are neither co-existent nor completely congruent. The surfaces are considered spheroid or ovoid rather than spherical.

The femoral head is covered by articular cartilage except for a rough pit for the ligament of the head (ligamentum teres). In front, the cartilage extends laterally over a small area on the adjoining neck. The cartilage is thickest centrally. Maximum thickness is in the acetabulum's anterosuperior quadrant and the anterolateral part of the femoral head.

The acetabular articular surface is an incomplete ring, the lunate surface, broadest above where the pressure of the body weight fall in erect posture. It is deficient below, opposite to the acetabular notch. The acetabular fossa within it is devoid of cartilage, but contains fibroelastic fat largely covered by synovial membrane.

Acetabular labrum:

It is a fibroacartilagenous rim attached to the acetabular margin, deepening the cup. It is triangular in cross section and its base is attached to the acetabular rim with the apex as the free margin. It bridges the acetabular notch as the transverse acetabular ligament, under which vessels and nerves enter the joint.

Fibrous capsule:

It is strong and dense attached above to the acetabular margin 5-6mm beyond the labrum, in front to the outer and lateral aspect and near the acetabular notch to the transverse acetabular ligament and the adjacent rim of the obturator fossa. Behind, it is attached about 1 cm above the inter-trochanteric crest. Below it is attached to the femoral neck near the lesser trochanter. Anteriorly, many fibres ascend along the femoral neck as longitudinal retinacula containing blood vessels for both the femoral head and neck. The capsule is thicker antero superiorly, where maximal stress occurs, especially in standing. Postero-inferiorly it is thin and loosely attached. The capsule has two layers - inner circular, forming the zona orbicularis around the femoral neck and blending with the pubofemoral and ischiofemoral ligaments, and an outer longitudinal layer. The circular layer is not directly attached to bone

Synovial membrane:

Starting from the femoral articular surface, it covers the intracapsular part of the femoral neck, then passes to the capsule's inner surface to cover the labrum, ligament of the head and the fat in the acetabular fossa. It is thin on the deep surface of the iliofemoral ligament, where it is compressed against the femoral head. It communicates with the subtendinous iliac (psoas) bursa by a circular aperture between the pubofemoral and the vertical band of the iliofemoral ligament.

Iliofemoral ligament:

It is also known as Bigelow's ligament. Triangular or inverted 'Y shaped. It is one of the strongest ligaments in the body. Its apex is attached between the anterior inferior iliac spine and the acetabular rim, and its base to the inter trochanteric line anteriorly.

Pubofemoral ligament:

It is triangular with the base attached to the iliopubic eminence, superior pubic ramus, obturator crest and membrane. Distally it blends with the capsule and deep surface of the medial part of iliofemoral ligament.

Ischiofemoral ligament:

It consists of superior ischiofemoral ligaments and the lateral and medial inferior ischiofemoral ligaments, extending from the ischium to the base of the femoral neck on the posterior aspect of the joint.

Ligamentum teres:

It is a triangular flat band with apex attached to the pit on the femoral head and base on either side of the acetabular notch. It varies in length and sometimes being represented only by a synovial sheath

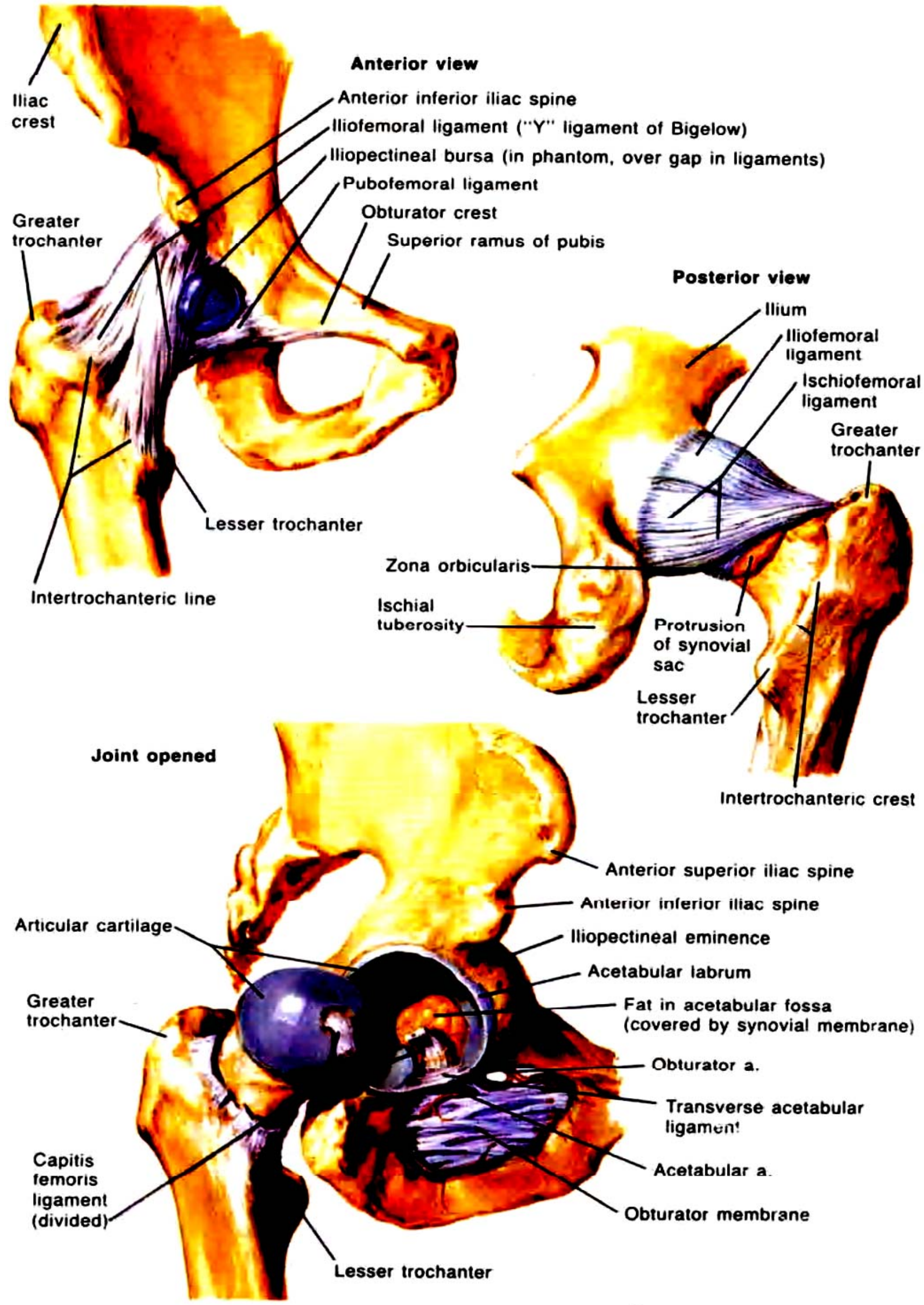


Fig. 1 : Ligaments of Hip Joint

PROXIMAL END OF THE FEMUR

The femur is the longest bone in the human body. The upper end of femur comprises of a head, a neck, a greater trochanter and a lesser trochanter.

The Head:

The head is slightly more than half a sphere. It is directed medially upwards and slightly forwards. It articulates with the acetabulum to form the Hip joint. The medial convexity of the head has a pit, the **fovea**, situated just below and behind its center, providing attachment to the **ligament of the head** of the femur {round ligament/ligamentum teres}. The head is entirely intra-capsular and is encircled immediately lateral to its greatest diameter by the labrum acetabulare. The circumference of the head is sharply defined, except anteriorly where the cartilage covered surface extends on to the front of the neck.

The Neck:

The neck connects the head of the femur with the shaft. It is about 1.5 inches long. As the neck inclines upwards and medially, it makes an angle with the shaft, the **Neck Shaft Angle**, which is about 125^o $to140^0$ in adults. This facilitates movement at the hip joint, enabling the limb to swing clear of pelvis. The neck is also tilted forwards as it passes upwards and medially from the shaft. As an account of this the transverse axis of the neck and head makes an angle with the transverse axis of the lower end of the femur, known as the **Angle of Anteversion**, which is approximately 10^0 to15^o. The neck is strengthened along its concavity by the **calcar femorale**.

The neck is ridged particularly on the anterior aspect, indicating the attachment of retinacular fibers of the hip joint capsule, which are reflected proximally from the distal attachment of the capsule. Many vascular foraminae, directed towards the head, perforate the anterior and posterior surfaces of the neck.

The Greater Trochanter:

The greater trochanter is a large, quadrangular projection, projecting up and back from the convexity of the junction of the neck of the femur with the shaft. The upper border of the greater trochanter lies one hand breadth below the tubercle of the iliac crest and is on level with the center of the femoral head. The Greater Trochanter has an upper border, an apex and three surfaces - anterior, medial and lateral. The **upper border,** projects into an inturned **apex**. Posteriorly the apex continues down as the intertrochanteric crest to the lesser trochanter. The medial surface of the upper border of the greater trochanter has the attachment of the piriformis and is known as, the ***piriformis fossa***. The **anterior surface** shows a J shaped ridge for the attachment of the gluteus minimus tendon. The **medial**

surface provides attachment for the common tendon of obturator internus and gamelli and at the bottom is the rough ***trochanteric fossa*,** for the attachment of the obturator externus. The **lateral surface** shows an oblique strip sloping downwards and forwards providing attachment for the gluteus medius. There is a trochanteric bursa of the gluteus medius in front of the ridge and of the gluteus maximus behind the ridge.

The Lesser Trochanter:

The lesser trochanter is a conical eminence. It is directed medially and backwards from the shaft at the lowest part of the neck. Its rounded surface medially provides attachment for the psoas major tendon.Iliacus is inserted into the front of this tendon and into the bone below the lesser trochanter. The smooth posterior surface is covered by a bursa deep to the upper horizontal fibers of adductor magnus.

The Intertrochanteric Line:

It marks the junction of the anterior surface of the neck with the shaft of the femur. It is a prominent roughened ridge, which begins proximally at the anterosuperior angle of the greater trochanter as a tubercle, and runs downwards and medially continuing below with the spiral line in front of the lesser trochanter. The spiral line winds round below the lesser trochanter to the posterior surface of the shaft.

The intertrochanteric line provides attachment to:

- The capsular ligament of the hip joint.
- The upper band of the Iliofemoral ligament at the upper end.
- The lower band of the Iliofemoral ligament at the lower end.
- Highest fibers of the Vastus lateralis from the upper end.
- Highest fibers of the Vastus medialis from the lower end.

The Intertrochanteric Crest:

It marks the junction of the posterior surface of the neck with the shaft. It is a smooth rounded ridge, which commences at the postero-superior angle of the greater trochanter and runs downwards and medially to terminate at the lesser trochanter.Nearly halfway down the crest is an oval eminence, the ***quadrate tubercle***, providing attachment for the quadratus femoris. Above the tubercle the crest is covered by the gluteus maximus, and below the tubercle it is separated from the gluteus maximus by the quadratus femoris and the upper border of the adductor magnus.

BLOOD SUPPLY

The arterial supply of the proximal end of the femur has been studied extensively. The description of **Crock H.V.**[29] seems to the most appropriate. The arteries of the proximal end of femur are described in three groups:

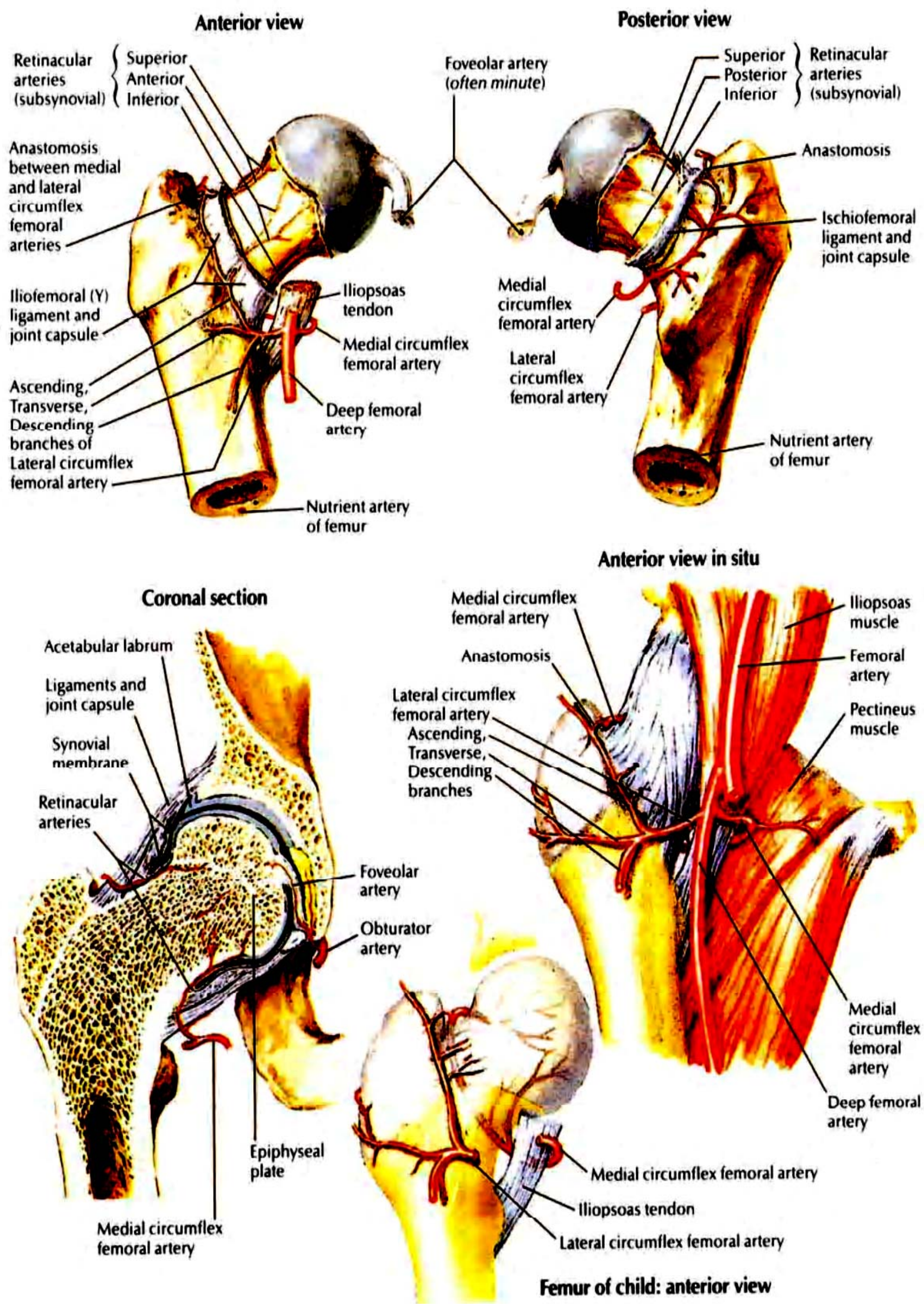


Fig. 2 : Vascular Supply of Femoral Head and Neck

1. Extracapsular arterial ring located at the base of the femoral neck.
2. Ascending cervical branches from the extracapsular arterial ring on the surface of the femoral neck.
3. The arteries of the round ligament.

1. Extracapsular Arterial Ring: is formed posteriorly by a large branch of the medial circumflex artery and anteriorly by branches of the lateral femoral circumflex artery.The superior and inferior gluteal arteries also have minor contributions to this ring.

2. Ascending Cervical Branches: arise from the extracapsular arterial ring. These branches pass upward under the synovial reflections and fibrous prolongations of the capsule toward the articular cartilage. These arteries are known as **retinacular arteries**, described by**Weitbrecht**.

The ascending cervical arteries can be divided into four groups [anterior, medial, posterior, lateral], based on their relationship to the femoral neck. At the margin of the articular cartilage on the surface of the femoral neck these vessels form a second ring, the **Subsynovial Intra-articular Arterial Ring** of **Chung**[30]. This ring was initially termed the **Circulus Articuli Vasculosis** by **William Hunter** in 1743.**Treuta** and **Harrison**[31] mentioned an incomplete ring in 1953. From the subsynovial ring, **epiphyseal arterial branches** arise that enter the head of the femur.

3. The **artery** of the **Ligamentum Teres** (foveolar /medial epiphyseal artery) is a branch of the obturator or the medial circumflex artery. They are responsible only for a small area of subsynovial circulation.

NERVE SUPPLY

Hilton's rule: The nerve that supplies a muscle acting across a joint supplies the joint itself and the skin over the joint. Thus hip joint is supplied by

- Femoral nerve or its muscular branches.
- Obturator nerve.
- Accessory obturator nerve.
- Nerve to Quadratus femoris.
- Superior gluteal nerve

KINESIOLOGY OF THE HIP

MOVEMENTS	MUSCLES (Prime Movers and Assisted by)	AXIS
Flexion	Psoas major, Iliacus, Pectineus, Rectus femoris, Sartorius, Adductor Longus (in early flexion from full extension)	Along the centre of femoral neck (pure spin)
Extension	Gluteus maximus, Posterior hamstrings	Along the centre of femoral neck (pure spin)
Abduction	Gluteus medius and minimus Tensor fasciae latae sartorius	Antero-posterior through femoral head
Adduction	Adductors longus, brevis and magnus, Gracilis, Pectineus	Antero-posterior through femoral head
Medial Rotation	Tensor fasciae latae and Anterior fibres of Gluteus, medius and minimus	Vertical axis through centre of femoral head and lateral condyle with foot stationary on the ground
Lateral Rotation	Oburator Externus and Internus, Gemelli, Quadratus femorus, Assisted by Piriformis, gluteus maximus and Sartorius.	Vertical axis through centre of femoral head and lateral condyle with foot stationary on the ground.
This mechanical axis of the hip is not dynamic relative to the femur. It is stationary during pure spins. It moves relative to its co-articular surface in chordal or arcuate paths during pure or impure swings respectively.		

Table.1: Kinesiology of Hip Joint

INTERNAL STRUCTURE OF THE PROXIMAL END OF FEMUR

The apparently fragile but collectively strong lattices of the struts and trusses seen in trabecular bone and skeletal forms such as tubes, H-girders and ridges predate human invention by millennia. **Galileo** recognized the significance of trabeculation and also asserted that hollow cylinders are weight for weight, stronger than solid rods.

Calcar femorale:

A thin vertical plate, the calcar femorale or as Bigelow (1900) described it as the true neck of the femur. It ascends from the compact wall near the linea aspera into the trabeculae of the neck. Medially it joins the posterior wall of the neck. Laterally it continues into the greater trochanter dispersing into the general trabecular bone. It is thus in a plane anterior to the trochanteric crest and base of the lesser trochanter. The hip prosthesis, rests on the calcar, and its shoulder abuts the calcar femorale and transmits the stress of weight bearing to the shaft via the calcar.

Trabecular Pattern:

The cancellous bone of the upper-end of the femur is composed of two distinct systems of trabeculae. In the frontal section these trabeculae are seen to form two arches. One arising from the medial (or inner) cortex of the shaft of the femur and the other taking origin from the lateral (or outer) cortex. The trabeculae forming these arches are called compressive and tensile trabeculae respectively because they are disposed along the lines of maximum compression and tension stresses produced in the bone during weight bearing. These trabeculae have been divided into following five groups:

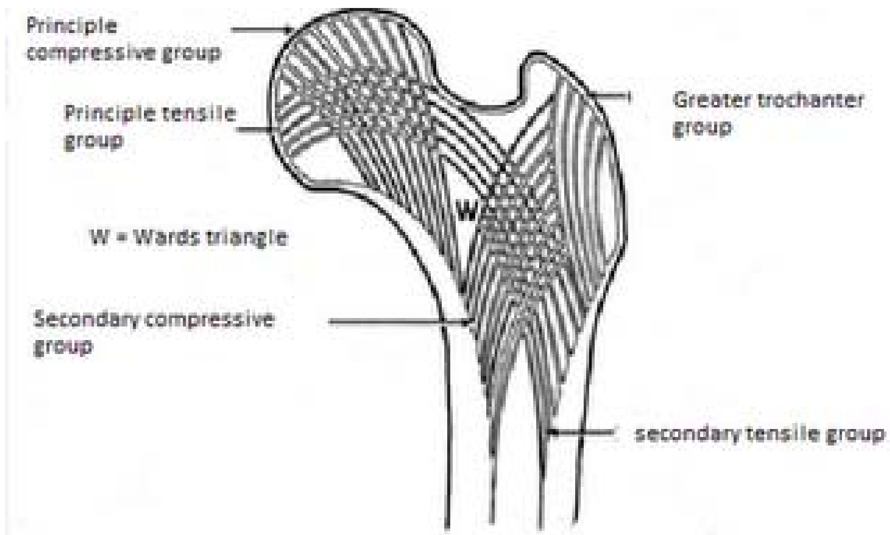


Fig. 3 : Trabecular pattern

a. Primary compressive group: The upper most compression trabeculae extend from the medial cortex of the shaft to the upper portion of the head of the femur run in a slightly curved radial lines. Some of these are thickest and most closely packed.

b. Secondary compressive group: The rest of the compression trabeculae which arise from the medial cortex of the shaft constitute the secondary compressive group. These arise below the primary compressive group and curve upwards and laterally towards the greater trochanter and the upper portion of the neck. The trabeculae in this group are thin and widely spaced.

c. Primary tensile group: The trabeculae which spring from lateral cortex immediately below the greater trochanter group. These trabeculae are thickest among the tensile group curve upwards and inwards across the neck of the femur to end in the inferior portion of the femoral head.

d. Secondary tensile group: The trabeculae which arise from the lateral cortex below the primary tensile trabeculae. The trabeculae of this group arch upwards and medially across the upper end of the femur and more or less irregularly after crossing the midline.

e. Greater trochanter group: Some slender and poorly defined tensile trabeculae arise from the lateral cortex just below the greater trochanter and sweep upwards to end near its superior surface.

In the neck of femur, the principle compressive, the secondary compressive and primary tensile trabeculae enclose an area containing some thin and loosely arranged trabeculae. This area is called "Ward's Triangle".

The trabeculae of the upper end of the femur can be studied by making roentgenograms of the hip region using an exposure sufficient to delineate the macroscopic details of the internal architecture of bones. The thick trabeculae appear as dense continuous lines while the delicate ones are not visible. Thus the areas like Ward's triangle appear empty while rest of the trabeculae are delineated depending on their density.

Singh's Index:

The 'Singh's Index' [32] is the grading of the trabecular appearance in X-ray. There are six grades as follows:

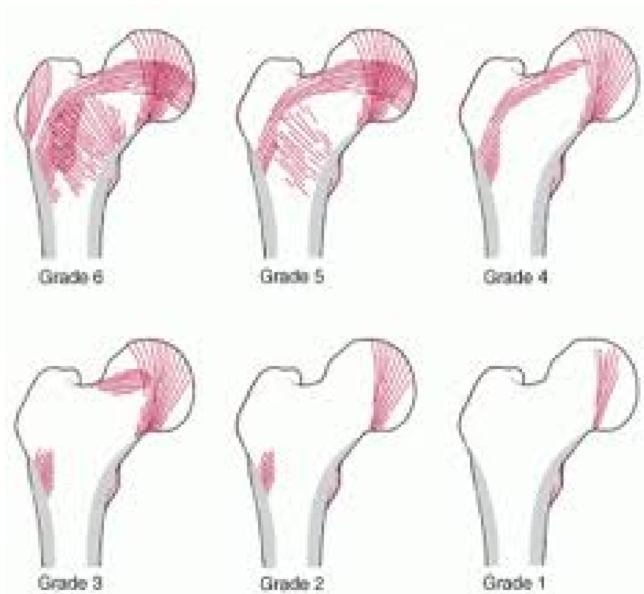


Fig. 4. Singh’s Index

Grade VI: All the trabeculae groups are visible. Upper end of the femur is completely cancellous.

Grade V: Primary tensile and compressive trabeculae are accentuated. Ward's triangle is prominent. Secondary trabeculae are absent.

Grade IV: Primary tensile trabeculae are reduced. But still can be traced from the lateral cortex to the upper end of the femur.

Grade III: Break in the tensile trabeculae opposite the greater trochanter.

Grade II: Only Primary compressive trabeculae are found. Others are more or less completely resorbed.

Grade I: Even Primary compressive trabeculae are markedly reduced.

APPLIED BIOMECHANICS OF HIP JOINT

When the weight of the body above the lower extremities rests equally on two normal hip joints, the static force on each hip is one half of, or less than one third, the total body weight. When, for example, the left lower extremity is lifted as in the swing phase of walking, the weight of the left lower extremity is added to that of the body weight, and the centre of body gravity, normally in the median sagittal plane, is displaced to the left. The abductor muscles exert a counter-balancing force to maintain equilibrium. The pressure exerted on the head of the right femur is the sum of these two forces. Each force is related to the relative length of levers. If the abductor lever is one third that of the lever arm from the head to the centre of gravity, the downward pull of the abductors must be three times the force of gravity to maintain balance. Therefore, the total pressure on the head is four times the superimposed weight. The longer the abductor lever (i.e., the more laterally placed insertion of the abductors), the less the ratio between the levers, the less the abduction force required to maintain balance, and the less the pressure force on the femoral head.

The estimated load on the femoral head in the stance phase of gait and during straight leg rising is about 3 times the body weight. Crowninshield, et al.[33]calculated peak contact forces across the hip during gait as ranging from 3.5 to 5 times the body weight. When lifting, running or jumping the load may be upto 10 times the body weight.

The forces on the joint act not only in the coronal plane, but as the body's center of gravity (in the mid line anterior to S2 vertebral body) is posterior to the axis of the joint, they also act in the sagittal plane to bend the stem of the prosthesis posteriorly.[34]

During the gait cycle, forces are directed against the prosthetic femoral head from a polar angle between 15 and 25 degrees anterior to the sagittal plane of the prosthesis. During stair climbing and straight leg raising, the resultant force is applied at a point even further anterior on the head. Such forces cause posterior deflection or retroversion of the femoral component.

Co-efficient of Friction of implant:

The low coefficient of friction of a metallic head articulating with a polyethylene cup as a bearing is fundamental to bipolar arthroplasty. The coefficient of friction is the measure of the resistance encountered in moving one object over another. It varies according to the material used, the finish of the surfaces of the materials, the temperature, and whether the device is tested in the dry state or with a specific fluid as a lubricant. Load may be another factor.

Frictional Torque force:

This is produced when the loaded hip moves through an arc of motion. It is the product of the frictional force times the length of the lever arm.[35]

Neck length and offsets:

The ideal femoral reconstruction reproduces the normal centre of rotation of femoral head this location is determined by 3 factors.[35]

- Vertical height (Vertical offset) – Restoring this distance is essential to correct leg length. Using a stem with variable neck lengths provides a simple means of adjusting this distance.
- Medial offset (Horizontal offset) – In adequate restoration of this offset shortens the moment arm of the abductor musculature and results in increased joint reaction force, limp and bony impingement which may results in dislocation.
- Version of the femoral neck (Anterior offset) – Version refers to the orientation of neck in reference to the coronal plane and is denoted as anteversion or retroversion. Retroversion of the femoral neck is important in achieving stability of the prosthetic joint. The normal femur has 10 to 15 degrees of anteversion.

INTERTROCHANTERIC FRACTURES

An intertrochanteric fracture was described by Cooper in his treatise of 1851 as follows:

"fracture of the femur through the trochanter major, passes obliquely upwards and outwards from the lower portion of the neck but instead of traversing the neck completely, it penetrates the base of the trochanter major; the line of fracture being such as to separate the femur into two fragments, one of which is composed of the head, neck and trochanter major, and the other of the shaft with the remaining portions of the femur"

Intertrochanteric fractures are the most frequent fractures of the proximal femur and occur predominantly in geriatric patient and are among the most devastating injuries in the elderly. Several epidemiological studies have suggested that the incidence of fractures of the proximal femur is increasing since the general life expectancy of the population has increased significantly during past few decades. Most proximal femoral fractures occur in elderly individuals as a result of only moderate or minimal trauma. In younger patients these fractures usually result from high energy trauma.

Aetiology :

The aetiology of intertrochateric fracture is multifactorial. The most common situation is an episode of minor trauma in an ageing patient whose bones have been weakened by a combination of post-menopausal and senile osteoporosis.

The increasing bone fragility results from osteoporosis and osteomalacia secondary to a lack of adequate ambulation or antigravity activities, as well as decreased hormone levels, increased levels of demineralizing hormones, decreased intake of calcium and/or vitamin D, and other aging processes. Benign and malignant tumors, along with metastases such as multiple myeloma and other malignancies, can also lead to weakened bony structure.

Biomechanics of Hip fractures:

The mechanism of bone failure: A structure will fail if it suffers an overload situation. An overload situation will occur if the system is unable to absorb the energy that is applied to it. In the hip joint area this overload situation can occur as a result of number of independent but often interrelated factors, the following being important.

1. Falling
2. Impairment of energy absorbing mechanics
3. Bone weakness.

During the fall, impairment of energy absorbing mechanisms and bone weakness, all may contribute more so for femoral neck fractures, they also do so for fractures of the trochanter. Even direct blows over the greater trochanter causing these fractures being unlikely, it is mostly due to failure of the bone to withstand sudden bending or twisting forces acting on it when the patient is about to fall from standing position, impairment of energy absorbing mechanisms particularly in the elderly and bone weakness, again usually in the elderly and more so in females (as the incidence the world over indicates) adding to the causes of the fracture of the trochanter.

Clinical features:

The limb is usually markedly shortened with external rotation deformity. The external rotation deformity is usually greater than that seen in patients with intracapsular fractures of the neck of femur. There may be swelling in the hip region and ecchymosis over the greater trochanter.

Other features are

- Tenderness over greater trochanter
- Positive Bitrochanteric compression test
- Shifted up Palpatory Bryants triangle
- Broadening and irregularity of greater trochanter

Radiographic and Other Imaging Studies:

1) Standard radiographic examination of the hip includes

a) Anteroposterior view of the pelvis

b) Cross table lateral view of the involved proximal femur

Anteroposterior view is useful to identify fracture obliquity, quality of the bone, and allows comparison of the involved side with the contralateral side to identify non displaced and impacted fracture. The lateral view help to assess size, location and comminution of posterior fracture fragment and helps to determine the fracture stability.

2) Technetium bone scan – when a hip fracture is suspected but not apparent to standard radiographs, it requires 2-3 days to become positive.
3) MRI – has shown to be least as accurate as bone scanning in identifying occult fractures of the hip, it will reveal a fracture within 24 hours of injury.

CLSSIFICATIONS

"A classification is useful only if it considers the severity of the bone lesion and serves as a basis for treatment and for evaluation of the results". - *Maurice E Muller*

Commonly fractures are described by the number of 'parts' (fragments) and instability. The presence of certain fracture characteristics such as displaced postero-medial fragment shattered lateral wall, indicate instability. There are several classifications.

- Evans classification
- Ranadier classification
- The Briot classification

- The Enders classification
- The AO classification
- Boyd and Griffin classification

Boyd and Griffin (1949) classification:

This classification includes all the fractures from the extracapsular part of the neck to a point 5cm distal to the lesser trochanter.

Type 1:

Fractures that extend along the intertrochanteric line from the greater to the lesser trochanter. Reduction usually is simple and is maintained with little difficulty. Results generally are satisfactory

Type 2:

Comminuted fractures, the main fracture being along the intertrochanteric line but with multiple fractures in the cortex. Reduction of these fractures is more difficult because the comminution can vary from slight to extreme.A particularly deceptive form is the fracture in which an anteroposterior linear intertrochanteric fractures occurs, as in type I, but with an additional fracture in the coronal plane,which can be seen on the lateral radiograph.

Type 3:

Fractures that are basically subtrochanteric with at least one fracture passing the proximal end of the shaft just distal to or at the lesser trochanter. Varying degree of comminution are associated. These fractures are usually more difficult to reduce and result in more complications at operation and during convalescence.

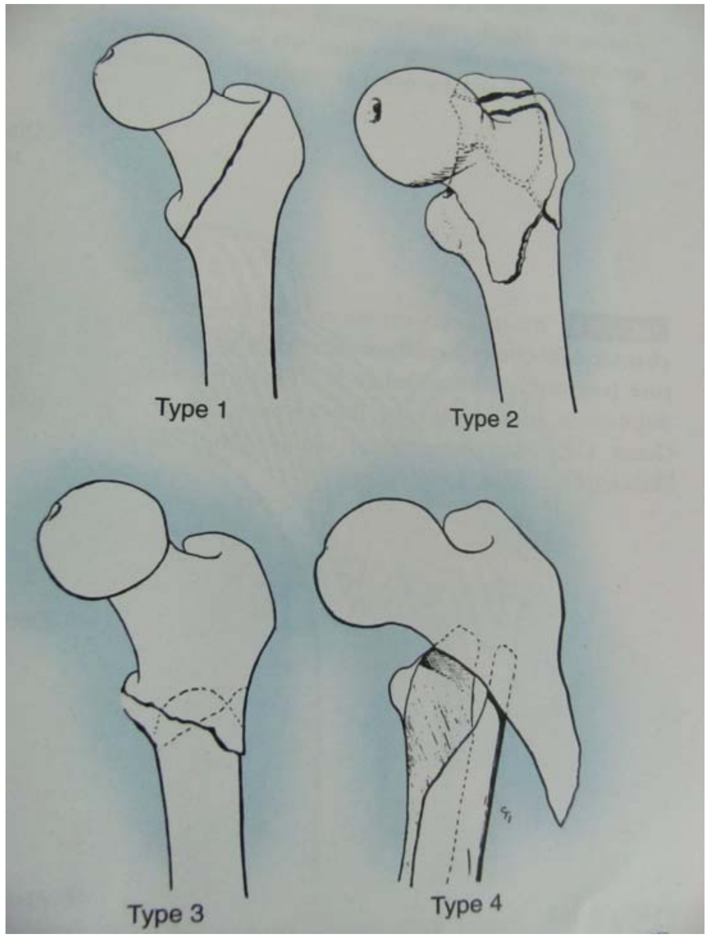


Fig. 5:Boyd &Griffin's Classification

Type 4:

Fractures of the trochanteric region and the proximal shaft, with fracture in atleast two planesone of which usually is the sagittal plane and may be difficult to see on routine anteroposterior radiographs.If open reduction and internal fixation is used two plane fixation is required because of the spiral ,oblique,or butterfly fracture of the shaft.

A.O. Classification: Muller et al in 1980-1987.

A1: Simple (2 fragment) pertrochanteric area fracture

A1: 1. Fractures along the intertrochanteric line

A1: 2. Fractures through the greater trochanter

A1: 3. Fractures below the lesser trochanter

A2: Multifragmentary pertrochanteric fractures

A2: 1. With one intermediate fragment (lesser trochanter detachment)

A2: 2. With 2 intermediate fragments

A2: 3. with more than 2 intermediate fractures

A3: Intertrochanteric fracture

A3: 1. simple, oblique

A3: 2. simple, transverse

A3: 3. with a medial fragment

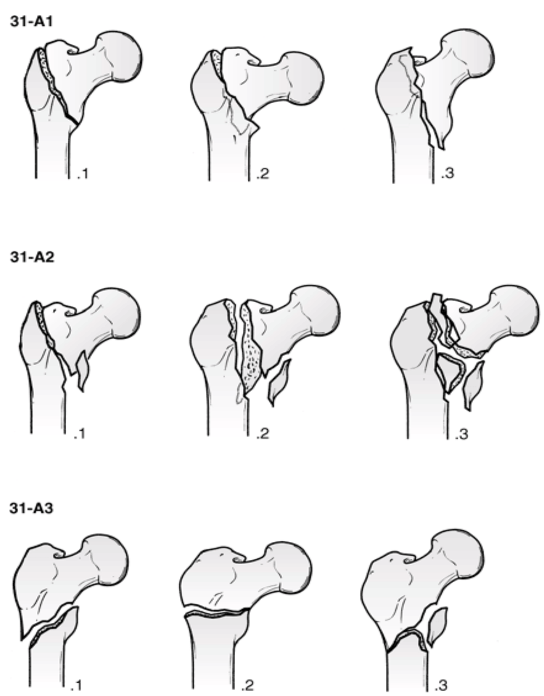


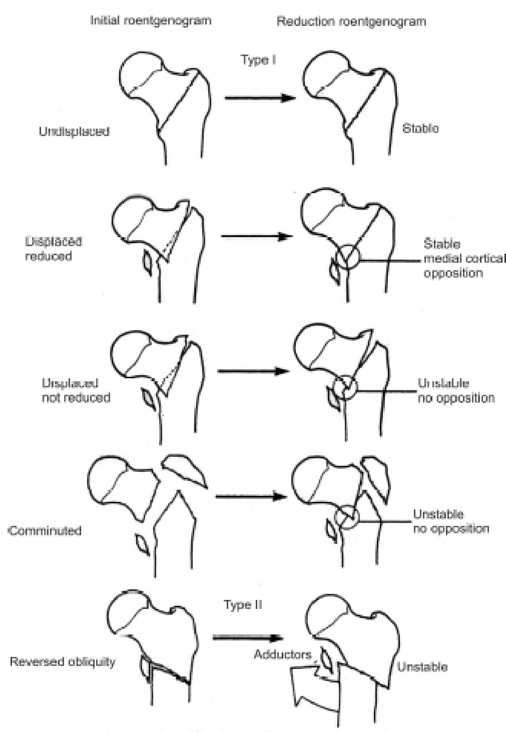
Fig . 6: A.O.Classification of Intertrochanteric Fractures

Evans classification:

Type 1: The fracture line extends upwards and outwards from the lesser trochater.

Type 2: The fracture line is of reversed obliquity, the major fracture line extends outward and downward from the lesser trochanter and are unstable.

A widely used classification system based on the stability of the fracture pattern and the potential to convert an unstable fracture pattern to a stable reduction.Evans observed that the key to a stable reduction is restoration of posteromedial cortical continuity



Evans classification of intertrochanteric
fractures based on direction of fracture

Fig. 7 .Evan’sClassification

Treatment options for intertrochanteric fractures:

1. Dynamic Hip Screw
2. Dynamic Condylar Screw
3. 95^0 Fixed Angle Blade Plate
4. External Fixator
5. Proximal Femoral Nailing
6. Replacement Arthroplasty – Hemiarthroplasty or Total Hip Replacement

ARTHROPLASTY IN INTRTROCHANTERIC FRACTURES

Cemented hemiarthroplasties and bipolar replacement are considered in unstable intertrochanteric fractures with osteoporotic bone in elderly patients. Haentejens et al,[42] compared the results of primary bipolar replacement and Blade plate fixation and reported few complications after cemented hemiarthroplasties. Earlier this procedure was done as a secondary treatment for the salvage of failed intertrochanteric fracture. Unstable intertrochanteric fractures, especially badly comminuted are common situations where fracture goes into non-union along with lot of morbidity and mortality. To overcome such situations and to prevent morbidity presently these patients are infrequently subjected to primary hip joint replacement. This has two advantages: it reduces the chance of nonunion and avoids morbidities and repeated surgeries. .

Hemiarthroplasty is the best option to treat failed hipscrews with fracture of greater trochanter in case of destructed femoral head. This was observed in a study done by Hsu CJ, Chou wy et al (2007) [43], in Taiwan, by treating 16 patients of failed hipscrew. In a study done by SKS Marya et al (2008)[45], in New Delhi has observed that treating intertrochantric fracture with Total hip replacement and Bipolar arthroplasty gives almost equal results and proved to be effective.

Similarly in other study done at Norway by Gjertsen et al (2008) [44], has observed better functional outcomes when patients treated with Hemiarthroplasy when compared with internal screw fixation. Likewise another study has reported 75% excellent results when 37 intertrochantric fractures treated with primary bipolar arthroplasty compared to internal fixation of screws by Haentijens P et al. [58]

Principle of bipolar prosthesis:

Acetabular wear is diminished. through reduction of total amount of motion that occurs between the acetabulum and metallic outer shell by the interposition of a second low-friction interbearing within the implant Because of compound bearing surface, bipolar designs provide greater overall range of motion than either unipolar designs or conventional total hip arthroplasty.

Recent Modifications of Bipolar Prosthesis:

Axes of metallic and polyethylene cups are now eccentric so that with loading of hip, metallic cup rotates laterally rather than medially, and thus avoids fixations in varus position and avoids impingement of head on edge of cup which causes friction of polyethylene bearings insert and dislocation.[36]

Dr. Della Pria introduced an Alumina Ceramic Bipolar Prosthesis the advantage of which is very low wear rate (2 microns/year compared to 200 microns of polyethylene per year).[37] However, polyethylene has an effect of protecting the subchondral bone from fractures. Therefore, the ceramic bipolar should have a PE jacket between the ceramic bearing surface and the outer head. A finite element analysis showed that such a jacket is effective at reducing the prosthesis stiffness.

Indications for Hemiarthroplasty:

1. Unstable fractures in elderly
2. Pathological fractures
3. Neglected fractures with deformity
4. Poor bone stock precluding internal fixation
5. Previous fixation failure

CHALLENGES IN CEMENTED BIPOLAR ARTHROPLASTY IN UNSTABLE INTERTROCHANTERIC FRACTURES

1. Restoration of limb length:

In severely comminuted intertrochanteric fractures the medial cortex also comminuted or the lesser tronchanter become a separate fragment. in prosthetic replacement the limb length can be maintained by using

1. Calcar replacing prosthesis
2. Medial cortex reconstruction with bone graft or cement mantle

Limb length equality can be assessed intra operatively by temporarily fixing the greater trochanter with the shaft described by Rodop et al[23],in their series. Sanchetti et al[27] , in their series achieved equal limb length by giving traction to the limb after putting prosthesis in the proximal femur then reducing the hip and comparing it with opposite limb. A mark was made on the prosthesis for easy identification during permanent fixation with cement later.

2. Restoration of anteversion:

This can be achieved peroperatively by temporarily fixing the lesser trochanter with the shaft.

3. Restoration of abductor mechanism:

In unstable intertrochanteric fractures the lateral cortex and greater trochanter are comminuted.Rodop et al,[23] in their series used stainless steel wires to attach the fractured greater trochanter with the prosthesis. Sanchetti et al, [27]in their series also used K-wires and stainless steel wires and bone cement for the fixation of greater trochanter.

4. Cementing technique:

Using bone cement in medically frail patients has it own complications ranging from anaphylaxis to presetting.These complication can be prevented by taking appropriate measures prior to cementing like pre loading the patient with fluids ,keeping emergency drugs readily available, alerting the anaesthesiologist prior to cementing,complete preparation of femoral canal before mixing the Cement or using slow setting cement.

COMPLICATIONS OF HEMIARTHROPLASTY

Early Complications:

1) **Nerve injuries:** The sciatic, femoral, obturator and peroneal nerves can be injured. The incidence of nerve injury has been reported to be 0.7% to 3.5% in primary arthroplasties [38.]

2) **Vascular injuries:** are rare however they can pose a threat to the survival of the limb and the patient.

3) **Haemorrhage and Haematoma formation:** It is common in case of familial bleeding tendency, recent salicylate use, anti coagulant therapy, liver disease, Paget's disease, Gaucher's disease and hemophilia.

4) **Limb length discrepancy:** Most often the limb that is operated had limb length discrepancy more commonly shortening of limb due to comminution of the medial cortex.

5) **Dislocation and Subluxation :** Factors contributing are

(i) Previous hip surgery (ii) Posterior approach (iii) Faulty positioning of implant (iv) Impingement of the femur on the pelvis (v) Inadequate soft tissue tension (vi) Weak abductor muscles . (viii) Improper of positioning of limb in postoperative period (ix) Soft tissue interposition.

6) **Fractures:** Fractures of femur can occur during insertion of implant. Post operative periprosthetic femoral fractures may be due to stress fractures.

7) **Infection:** Risk factors are diabetes, rheumatoid arthritis, sickle cell anaemia, urinary tract infections and prolonged operative time. Infection rate was almost 3 times higher in the posterior approach than the anterior approach.

8) **Thromboembolism:** This is the most serious complication of hemiarthroplasty. Risk factors are previous episode, venous surgery and varicose veins, prior orthopaedic operations, advanced age, malignancy and heart failure.

Late complications:

1) **Heterotopic ossification**: It is more commonly associated with excessive bone resection and soft tissue dissection.

2) **Implant loosening**: It is the most serious long term complication

3**) Acetabular protrusion**: This is assessed by measuring medialisation of acetabular line compare with normal or immediate post operative radiograph.

4) **Painful prosthesis**: Salvatti[39,40] (1972) and Coates (1975) felt that the principal late complication of endoprosthetic replacement is pain . Gringras (1980) and Whittaker[41] (1974) reported that the hip pain may be present with prosthetic loosening or with distal or proximal migration of the prosthesis.

MATERIALS AND METHODS

The present study on elderly patients with intertrochanteric fracture treated by cemented Bipolar hemiarthroplasty was conducted in Department of Orthopedics, Government Mohan Kumaramangalam Medical college hospital, Salem, during the period Aug 2008 to Sep 2010.

Study design:

Prospective study

Inclusion criteria:

1. Boyd & Griffin type 2, 3 and type 4 Intertrochanteric fractures of femur in patients with age more than 65years.
2. Failed previous fixation.

Exclusion criteria:

1. Patient below the age of 65 years.
2. Patients with dementia, nonambulatory and medicaly unfit.
3. Patients with psychological disorders.
4. Type I Boyd &Griffin Intertrochanteric fracture.

Sample size:

20 cases are selected for the study. On admission general condition of the patient was assessed. A thorough clinical examination was performed as per predesigned and pretested proforma including detailed history related

to age, sex, occupation, mode of injury, time since injury, past and associated medical illness and pre-injured morbid status.

The number of patients selected for our study were 20 which comprises of 8 male and 12 female patients. Common mean age was 71.4years. More number of patients were in the age group of 71-75 yrs (35%) with Mean age for male was 71.81yrs & Mean age for female was 69.92yrs.

Out of the 20 patients19 of them had their intertrochanteric fracture due to trivial trauma. Fall while walking in 8, due to fall from staircase in 3, low velocity motor vehicle accident in 7, and assault in1patient. One patient had a failed DHS fixation for intertrochanteric fracture due to implant cut-out.

On admission anteroposterior view X -ray of fractured limb was taken. The fractures were classified under Boyd & Griffin type of classification. Most number of patients (12) had type II intertrochanteric fracture. 5 patients were type III and 2 patients were type IV. One patient with previous implant failure was included. All the patients were evaluated clinically and radiologically to assess for any other associated injuries. Out of 20 patients only 7 patients had associated injuries apart from their intertrochanteric fracture.One patient had head injury operated for EDH on day one of admission. 2 patients had distal radius fractures which were treated conservatively and 4 patients had abrasions elsewhere in the body. 13 patients had no associated injuries.

Routine investigations like haemogram, blood sugar, urea, creatinine, serum electrolytes, chest X- ray, ECG, BT, CT, were done for all the patients on admission. 10 patients were free of any co- morbid conditions like DM, HT, IHD, and COPD. Other 10 patients had single or combined comorbid illnesses. Before taking up for surgery all the patients were made to be medicaly fit for anaesthesia and surgery. Out of 20 patients 10 of them stayed less than 10 days, 8 patients stayed10 to 20 days preoperatively. 2 patients stayed more than 20 days before the surgery for the control of their comorbid condition.

Table 2: Age & Sex distribution of the patients:

Age	**Male**	**%**	**Female**	**%**	**Total**	**%**
60-65	1	5	2	10	3	15
66-70	1	5	4	20	5	25
71-75	3	15	4	20	7	35
>75	3	15	2	10	5	25
Total	8	40	12	60	20	100

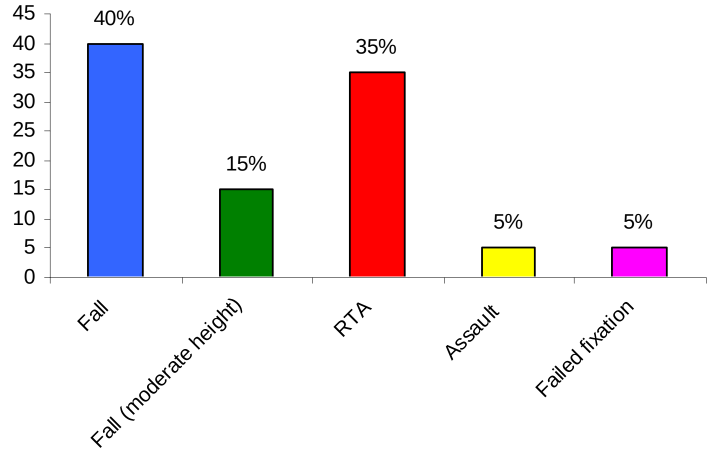


Figure 8: Bar diagram showing mode of injury:

Table 3: Descriptive statistics for the type of fracture according to Boyd & Griffin Classification:

Type of fracture	No. of patients	Percent
Type II	12	60
Type III	5	25
Type IV	2	10
Previous implant failure	1	5
Total	20	100

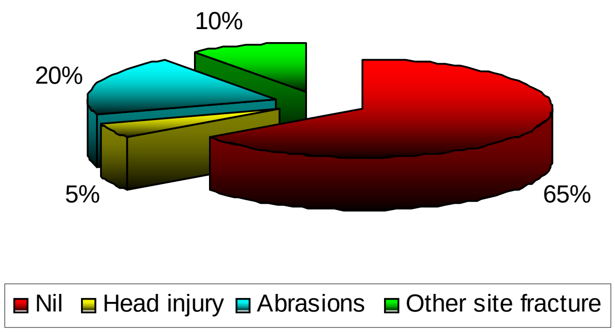


Figure 9: Pie diagram showing associated injuries:

Table 4: Descriptive statistics for the associated disorders:

Associated disorder	No. of patients	Percent
Nil	10	50
HTN	1	5
DM	2	10
DM + HTN	2	10
DM + HTN + IHD	4	20
COPD	1	5
Total	20	100

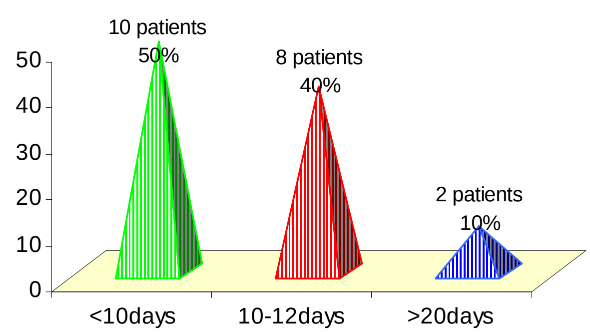


Figure 10: Bar diagram showing pre-op hospital stay:

Pre operative protocol

Along with routine investigations, additional tests were performed, depending on the patient's clinical findings, past and current medical history, and results of the screening laboratory studies and images. Any medical abnormalities were treated promptly and appropriately before surgical intervention. During this period, appropriate measures were instituted to decrease the possibility of a DVT and secondary pulmonary embolism. Preoperatively Skeletal traction or skin traction was applied.

Preoperatively, x ray was analysed for fracture pattern, degree of comminution and osteoporosis. Planning was done to reconstruct either the medial or the lateral cortex or both and if needed, the method of reconstruction and choice of implant based on fracture pattern. The size of the prosthesis is measured from opposite normal hip.

Written, explained consent of the patient and relatives was taken preoperatively. The affected limb was cleaned and shaved the day before the surgery and painted with an antiseptic solution and covered with sterile dressing. Appropriate broad-spectrum antibiotic was given half an hour prior to surgery. Spinal or epidural anesthesia was given as per direction of the Anesthesiologist.

Surgical technique:

All cases were operated using standard posterior approach in lateral position. From a point 10 cm distal to posterior superior iliac spine and extended distally and laterally parallel to the fiberes of gluteus maximus to the posterior margin of the greater trochanter and then directed downwards parallel to the femoral shaft. Deep fascia was exposed and divided in the line with the skin incision as also was the fascia over gluteus maximus, which was then split in the direction of its fibres using blunt dissection. By retracting the proximal fibres of the muscle proximally, the greater trochanter was exposed. Distal fibres were retracted distally and partly divided at their insertion into the linea-aspera in line with the distal part of the incision. The sciatic nerve was protected and gently retracted out of the way. The gemelli, obturator internus and the piriformis tendon were divided at their insertions after tagging them for easier identification and reattachment.

The posterior part of the capsule was exposed by pulling the greater trochanter with bone hook. Capsule was incised from distal to proximal along the line of neck of femur and at right angle to it, thus making a T shaped opening in the capsule. The fracture anatomy was assessed and a bonecut was taken in the neck for easy delivery of the head.

The head was levered out of the acetabulum and size measured using femoral head guage. Now there were three fragments namely the greater trochanter, the lesser trochanter, and the shaft with retained portion of the neck. The femoral shaft was rasped using a broach (rasp) and prepared for the insertion of the prosthesis. The head and neck portion proximal to fracture was removed fully.The anteversion and retroversion were determined by temporarily reconstructing lesser trochanter with the shaft.In 17 cases of type II &III fractures cancellous screws, stainless steal wiring or tension band wiring with K-wires were used to reconstruct the lateral cortex. Medial cortex was reconstructed with bone cement or bone graft taken from the medial cortex of neck, depending upon the degree of comminution.In 2 cases of type IV fractures the proximal shaft was reconstructed with cerclage wiring.In the case of DHS failiure with non union the implant was removed first through the previous incision and incision extended proximaly, rest of the procedures were followed as routine. Size of the prosthesis was measured and was confirmed using trial prosthesis by its suction fit in the acetabulum. The acetabulum was prepared by excising remaining ligamenturn teres and soft tissue.

The prosthesis was then inserted into the femoral shaft in about 5^0-10^0 of anteversion and impacted into the femur with bone cement using standard cementing techniques - lavage, cleaning, drying and plugging of the canal. The reduction of the prosthesis was then done using gentle traction of the thigh and stability of the hip joint was assesed. Absolute haemostasis was obtained. After suturing the capsule the external rotators were reattached with greater trochanter. The wound was closed in layers over a suction drain.

The duration of surgery was more than 90 minutes in 12 patients and less than 90 minutes in 8 patients. Maximum duration of surgery was 2 ½hours and minimum was 1 hour. Mean duration of surgery was 100 minutes. During surgery 13of our patients lost less than 300ml of blood, 7 had lost more than 300ml of blood. Those with type VI fractures and some type III fractures lost more blood during surgery and took more time for the reconstruction of medial cortex and restoration of abductor mechanism. Maximum blood loss was 400ml and minimum was 250ml. Average blood loss was 286.75ml. Out of the 20 patients 6 patients were transfused intra operatively and 8 patients needed postoperative blood transfusion.

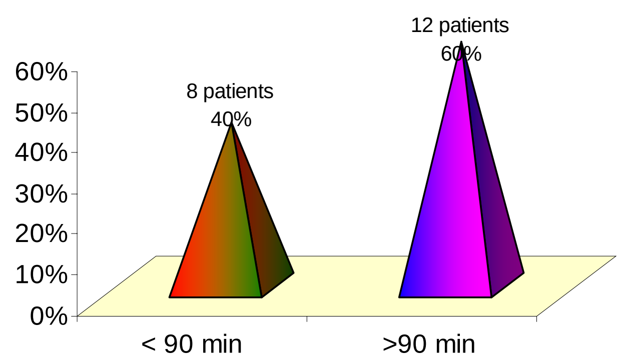


Figure 11: Diagram showing total duration of surgery:

Table 5: Distribution of patient by blood loss during surgery:

Blood loss in ml	No. of patients	Percent
Less than 300	13	65
More than 300	7	35
Total	20	100

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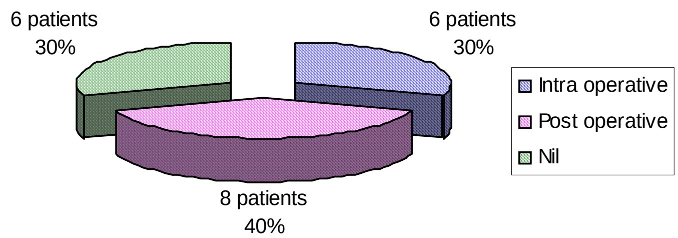

Figure 12: Diagram showing blood transfusion intra op & post op:

Postoperative management:

Postoperatively, foot end elevation was given depending on the patients postoperative blood pressure to prevent spinal headach. Every half an hour blood pressure, pulse rate, temperature, and respiratory rate were monitored for the first 24 hours. Intramuscular analgesics were given as per patient's compliance. Intravenous antibiotics were continued for 5 days. Drain removal was done after 48 hours at first change of dressing. Check radiograph was taken after 48 hours.

Physical therapy plan was fomulated for each patients based on their compliance, neurological status, method of reconstruction of cortex , comorbid conditions and associated injuries of the patient.

The patients were assisted out of bed and into a chair on the first post operative day. Bed nursing advises were given keeping in mind the operated limb should be kept in abduction. The assistance was gradually decreased until the patient can perform transfer independently. Ambulation training was initiated on the first or second postoperative day. We followed the rehabilitation protocol of Hospital for joint diseases[59].

Day 1	Dangle legs from bed, out of bed to chair, ambulation training with walker15ft(weight bearing as tolerated)
Day 2	Ambulation training 20 ft
Day 3	Ambulation training 40ft
Day 4	Stair climbing
Day 5	Progression of ambulation and stair climbing for endurance and distance with gradual decrease of assistance.

Table.6.Hospital for joint diseases rehabilitation protocol

Exercise and strength training were administered to the patient to tolerance on a daily basis. Supine exercises includes quadriceps sets, heel slides, active assisted hip flexion(up to 90^0), active assisted straight leg raising, active hip and ankle pumps. Sitting position exercises includes active knee extension, self assisted hip flexion exercise with a towel . Standing exercise includes straight leg raises while the patient hold the parrelel bars, hip flexion and quarter knee bend exercises progressed from active assisted to active and then to resistive. Adaptive equipments like standard walker, rolling walkers, canes are provided initially and gradually withdrawn.

Out of the 20 patients 8 patients started partial weight bearing on 1^{st} postoperative week.12 patients within 2^{nd} week. They were allowed to full weight bear and walk with the help of a walker depending on his/her pain tolerance and were encouraged to walk thereafter .Out of the 20 patients 6 of our patients started full weight bearing on 2^{nd} week,13 of our patients started at 3^{rd} week and 1 patients on 4th week.

Suture removal was done on the twelth postoperative day. The patients were assessed for any shortening or deformities and discharged from the hospital. 2 patients had superficial wound infection and were treated with appropriate antibiotics before discharging from the hospital. None of the patient developed bed sore. Almost all the patients were discharged within 15^{th} postoperative day. Out of 20 patients 15of them had overall hospital stay less than a month , 4 of them stayed 30-40 days and 1 of them more than 40 days. Mean overall hospital stay was 26.65 days.

Table 7: Distribution of the patients by postoperative hospital stay

Post-op hospital stay	**No. of patients**	**Percent**
<10 days	0	0
11-15 days	12	60
16-21 days	7	35
More than 21 days	1	5
Total	20	100

Table 8: Distribution of the Patients by overall hospital stay:

Total hospital stay	No. of patients	Percent
<20 days	7	35
21-30 days	8	40
31-40 days	4	20
More than 40 days	1	5
Total	20	100

Follow Up

At the time of discharge the patients were asked to come for follow up once in every 2 weeks upto 2 months, once in every 4 weeks for 1 year and for further follow up once in every 8 weeks there after.

At follow up, detailed clinical examination was done systematically. Patients were evaluated according to Harris hip scoring system for pain, limp, the use of support, walking distance, ability to climb stairs, ability to put on shoes and socks (in our study this criteria was assed by ability to cut toenail) sitting on chair, ability to enter public transportation, deformities, leg length discrepancy and movements. All the details were recorded in the follow up chart. The radiograph of the operated hip was taken at each follow up. At the end of study all the patients were assesed for functional outcome according to Harris hip score(HHS).Maximum follow up in our study was 2years and 1 month and Minimum follow up period was 9months. All the 20 patients returned for followup.

Harris hip scoring system;

The functional outcome was graded as following depending on the Harris hip score.

1. Excellent 90-100 2. Good 89-80 3. Fair 79-70 4. Poor <70

HARRIS HIP SCORE

Pain
- ☐ None or ignores it (44)
- ☐ Slight, Occasional, no Compromise in activities (44)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bad, bedridden (0)

Limp
- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support
- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked
- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoor Only (2)
- ☐ Bed and chair only (0)

Sitting
- ☐ Comfortably in ordinary chair for hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation
- ☐ Yes (1)
- ☐ No (0)

Stairs
- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on shoes and Socks
- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All Yes =4: Less than 4=0)

Less than 30* fixed flexion contracture Yes/ No

Less than 10* fixed abduction Yes/No

Less than 10* fixed internal rotation in extension yes/No

Limb length discrepancy less than 3.2 cm Yes/No

Range of Motion (“Indicate normal)

Flexion (“140”) ___________

Abduction (“40”) ___________

Adduction (“40”) ___________

External Rotation (“40”) ___________

Internal Rotation (“40”) ___________

Range of Motion Scale

211°-300° (5)	61°-100 (2)
161°-210° (4)	31°-60° (1)
101°-160° (3)	0°-30° (0)

Range of Motion Score ___________

Total Harris Hip Score: ___________

RESULTS AND ANALYSIS

In the present study, 20 patients with intertrochanteric fracture of femur were treated with cemented bipolar arthroplasty.

Follow up was done using harris hip score and following observations were made.

PAIN:

60% of patients didn't have any kind of pain. Slight pain in 3 patients (15%) and mild pain in 3 patients(15%) were observed. Moderate pain was observed in 2 patient (10%).

Table 9: Distribution of the patient by criteria of pain:

Criteria	Score	No. of patients	Percent
None	44	12	60
Slight	40	3	15
Mild	30	3	15
Moderate	20	2	10
Marked	10	0	0
Pain at bed	0	0	0
Total		20	100

Limping

Out of 20 patients 6(30%) patients had normal walking without any limping. 12(60%) of them showed slight limping during follow up . 2(10%) patients had moderate limping at the end of the study.

Table 10: Distribution of the patient by Criteria of Limping:

Criteria	**Score**	**No. of patients**	**Percent**
none	11	6	30
slight	8	12	60
moderate	5	2	10
severe	0	0	0
Total		20	100

Use of support:

Out of 20 patients 6(30%)of them able to walk without support. 9 of them**(**45%) used cane for long walks. 2 of the patients (10%) used cane most of the time for walking. 3 patient(15%) used one crutch for walking. Out of 20 patients 5 patients used cane for their walking before their fracture. Those 5 patients continued using cane even after surgery.

Table 11: Distribution of the patient by Criteria of Use of support:

Criteria	Score	No. of patients	Percent
None	11	6	30
cane for long walks	7	9	45
cane most of the time	5	2	10
One crutch	3	3	15
Two canes	2	0	0
Two crutches	0	0	0
Unable to walk	0	0	0
Total		20	100

Walking distance:

15(75%) of the patients can walk for longer distance with out any difficulty during follow up.2 patients(10%) were able to walk 6 blocks. 2patients (10%)were able to walk 2-3 blocks.Only 1 patient(5%) was not able to walk out side the house even after 6 months of surgery.

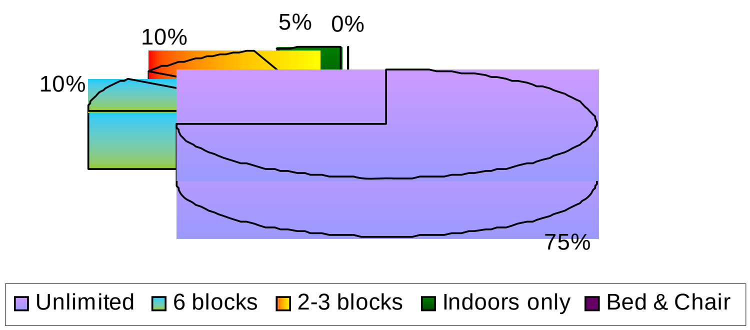

Figure 13: Pie diagram showing patients distribution by criteria of walking distance

Sitting:

14 of the patients (70%) were able to sit on ordinary chair for longer time and 5patients comfortably on high chair for ½ hour. Only one patient(5%) was not able to sit in the chair comfortably.

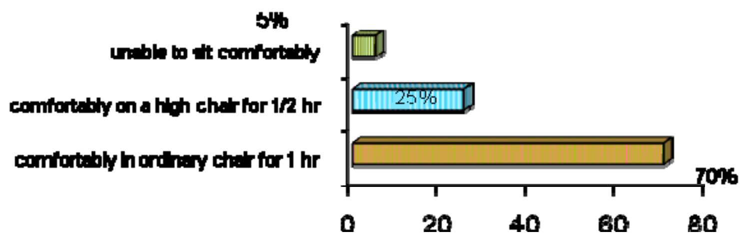

Figure 14: Diagram showing patients distribution by criteria of sitting:

Putting shoes:

Out of 20 patient 17(85%) of them were able to meet the criteria to put on shoes without any difficulty,2(10%) of them can able to put it with difficulty, where as only 1 (5%)patient was not able to do so.

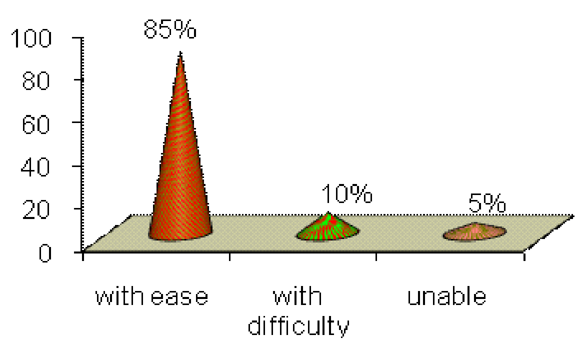

Figure 15: Diagram showing distribution of patients by criteria putting on shoes

Climbing stairs:

12 patients(60%) were able to climb the stair without using railing, but 5 patients(25%) needed railing to climb the stairs and 3patients(15%) use to climb any manner.

Table 12: Distribution of the patient by criteria of stair climbing:

Criteria	Score	No. of patients	Percent
Without using railing	4	12	60
Using a railing	2	5	25
Any manner	1	3	15
Unable	0	0	0
Total		20	100

Public transportation:

80% of the patients were using public transportation without any difficulty. 20% were finding it difficult during final follow up.

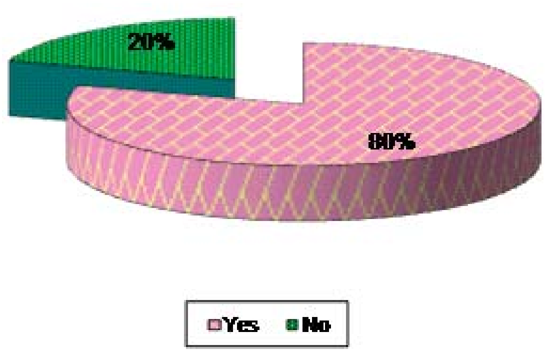

Figure16: Diagram showing distribution of patients on criteria of entering public transportation

Limb Length Discrepancy:

Out of 20 patients 7 patients (35%)showed no limb length discrepancy. 9 patients(45%) showed shortening of limb length of 0.5 to 1cm. 2 patients (10%) showed shortening of limb more than 1 cm. 2 of the patients(10%) showed lengthening of 0.5 to 1 cm. Mean limb length discrepancy was 0.9c.m.

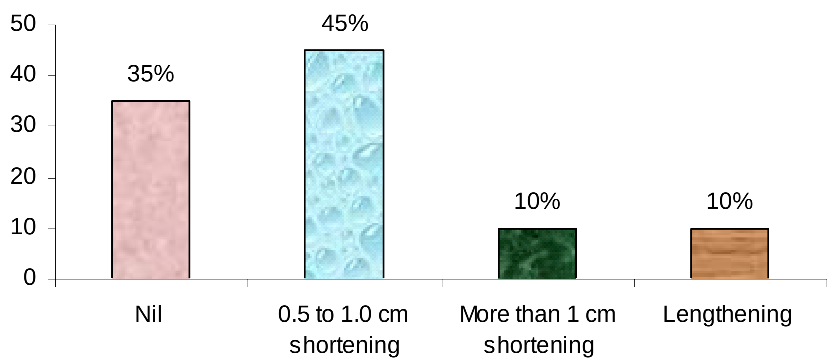

Figure 17: Bar diagram showing distribution by leg length discrepancy

Range of movements:

Out of 20 patients 6 patients(30%) showed excellent range of movement(211^0-300^0), 9 patients(45%) showed good range of movement (161^o-210^0), 3of the patients(15%) showed fair range of movement(101^o-160^0) and 2 patients (10%) showed poor range of (61-100^o) movement.

Table13 : Distribution of the patients by Range of movements

ROM	Score	No. of patients	Percent
211-300^0	5	6	30
161-210^0	4	9	45
101-160^0	3	3	15
61-100^0	2	2	10
31-60^0	1	0	0
0-30^0	0	0	0
Total		20	100

TOTAL HARRIS HIP SCORE:

Out of 20 patients 6 patients (30%) showed excellent, 6 patients (30%) showed good, 5 patients (25%) showed fair and 3 patients (15%) showed poor Harris hip score. Mean Harris hip score was 81.25.

Table 14: Distribution of patients according to their Harris hip score:

Harris hip score	Score	No. of patients	Percent
Excellent	90-100	6	30
Good	89-80	6	30
Fair	79-70	5	25
Poor	<70	3	15
Total		20	100

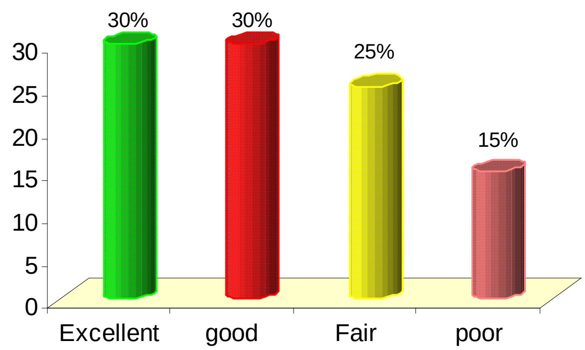

Figure 18: Pie diagram showing distribution of patients by Harris hip score

Complications:

70% of patients didn't have any complication. 3of them (15%) had Knee stiffness, 2 patients (10%) had superficial wound infection and 1 patient (5%) had foot drop as post operative complication.

Table 15: Descriptive Statistics of Complications in our series:

Complications	No. of patients	Percent
Death	0	0
Infection	2	10
Knee stiffness	3	15
Nerve palsy	1	5
Dislocation of prosthesis	0	0
Pulmonary complications	0	0
Nil	14	70
Total	20	100

DISCUSSION

A prospective study was done on management of unstable intertrochanteric fractures in elderly patients using cemented bipolar arthroplasty. The study was conducted among 19 elderly patients who had Boyd & Griffin’s type II, III & IV intertrochanteric fractures and 1 patient of failed fixation admitted in Govt. Mohan Kumaramangalam Medical College hospital, Salem during the period of August 2008 to September 2010.

Many studies were done, to show the effectiveness of cemented bipolar arthroplasty over other procedures. The present study has showed the effective results on treating patients with cemented bipolar arthroplasty.

Surgery in elderly patients:

In the present study, most of the patients (60%) belonged to the age group of more than 70 yrs. Their mean age group was 71.4 yrs. Similarly in an article given in Springer link journal of international orthopedics (2004)[46] among 54 elderly patients on whom surgery was done the mean age was 75.6 (64-91). Various studiess shows treating intertrochanteric fracture in the elderly by bipolar arthroplasy has reduced mortality & morbidity.

In a study done by Yin Q, Jiang Y et al, (2008) [47] in China in 2006, has reported 89 cases of comminuted intertrochanteric fractures treated with bipolar prosthesis has average age group of 82.6 yrs. Similarly in another study, 20 elderly patients with average age group 82.2 yrs with unstable intertrochanteric fracture were treated with bipolar head- neck replacement by Green, Stuard M.D et al, (1984) [48] has reported excellent results after surgery.

Sex incidence:

Intertrochanteric fractures are more common in females because of hormonal changes after menopause. The female preponderance in our study is similar to that of many studies.

In the present study, out of 20 patients, 12 (60%) were female and only 8 (40%) were male patients. Similarly G.S. Kulkarni et al, [1] in their study has observed 55% were females and 45% are males. Hunter and Krajbich [49] in their study have showed 62% were females and 38% were males who had intertrochanteric fracture.

Mode of injury:

This study was done on elderly patients.In this study mode of injury in 40% of the cases were due to trauma, like fall at home, slipping in the bathroom, etc. Road traffic accident was one of the causes of injury in another 40% of the cases. Incidence of trauma was 80% & 70% in the studies done by Hornby et al, [50] and Ganz et al, [51] respectively.

Type of Fracture:

In the present study the intertrochanteric fractures were classified according to Boyd and Griffin's classification. There were 12 type II, 5 type III,2 type IV and 1 old implant failure. In this study majority were type II fractures, which was the same as that observed by many other authors in the literature. The degree of comminution depends on the quality of bone, in the elderly individuals as the bone is osteoporotic the incidence of comminution is more.

Associated injuries & co morbid diseases:

In this study only 7 patients had associated other injuries. Associated injuries are less common because many of the injuries occured due to fall from minimal height.

Comorbid conditions were more in many studies because these studies were mainly done on elderly patients.In the present study 50% of the elderly patients are suffering mainly from non-communicable diseases like DM/HT/IHD/COPD etc. This factor influenced the duration between hospitalization and surgery and post operative stay

Duration of surgery and blood loss:

Duration of surgery depends upon the type of fracture, condition of the patient and the surgical skill of the surgeon.

The present study showed duration of surgery was less than 90 min in 40% of the patients and more than 90 min in 60% of the patients. The mean duration of surgery was 100 minutes (60-150 min). This study showed 65% of the patients had blood loss less than 300 ml and 35% lost more than 300 ml. The average blood loss was 286.75 ml (200-400 ml).

SKS Marya et al, (2008)[45] in their study after operating for 19 patients, has observed the mean duration of surgery was 60 minutes in bipolar arthroplasty. He had also reported that the mean blood loss for bipolar arthroplasty was 400 ml when compared to 600ml in Total hip replacement surgery.

Less duration & less blood loss has been observed in another study done by Yin Q, Jiang Y et al, (2008)[47].In that study, Surgery was done on 89 patients, Mean surgery duration was observed to be 62 minutes (50 min – 70 min) and mean blood loss was 150 ml (100 ml – 250 ml).

Sanchetti et al[27],in their study observed an average time of surgery was 71 minutes with an average blood loss of 350 ml. Broos et al,[52] concluded that the operative time, blood loss, and mortality were comparable between internal fixation and prosthetic replacement. Stappaerts et al,[53] found no difference between two groups except a higher transfusion needed in replacement group.

Total duration of hospital stay:

The present study shows 75% of the patients stayed in the hospital for less than 30 days. 20% of the patients stayed 30 to 40 days and 5% stayed more than 40 days. Average period of hospitalization was 26.65 days (16-43 days).

The patients were discharged two weeks after the surgery if there was no post-operative complication.The total duration of hospital stay in few cases was more than 4 weeks, due to delay in acceptance and consent for surgery and time taken for patients to be fit for anaesthesia due to comorbid conditions like HT/DM/IHD/COPD.

Some studies have reported average length of stay in the hospital was about 16 days, among total of 18 pts by Zhang Q et al, (2005)[54] and 18.6 days, among total of 89 patients by Yin Q et al, (2008) [47] respectively. Sanchetti et al[27], showed an average hospital stay of 10.96 day in their series of 35 intertrochanteric fractures treated with bipolar arthroplasty.

Pain:

Pain is an important criterion for the evaluation of intertrochanteric fractures treatment. Following surgery pain in the hip joint may be due to mechanical complications or infection. Almost 80% of patients had complaint of pain in the postoperative period.They were treated with analgesics and physical therapy and improved gradually in the followup period.

At the end of the study 60% of the patients were totally pain free and 15% of patients had slight pain and 15% of the patients have only mild pain. 10% of the patients had moderate pain even at the end of study. In two patients there was no mechanical complication, or infection or Secondary changes, but the patient still complained of pain in the hip joint.

Some other studies also quote less incidence of pain. Zhang Q et al[54], (2005)-in their study 10% and Gjerstsen JE et al, (2008) [44] in their study 14% when compared with other procedures, respectively. Mild pain was observed in 19 patients (63%) and severe pain in 2(6%) patients on the total of 30 elderly patients on whom surgery was done by Gallinaro et al, (1990)[55].

Ambulation and Range of movements:

In the present study all the patients were encouraged to do active hip and knee movements as soon as the pain and inflammation subsided. Most of the patients were able to walk in their 1st post operative week. Full weight bearing was delayed(4th week) in one patient.

Harwin SF et al, (1990) [56] in their study has reported 88% were able to ambulate within 1st post op week & 91% of the patients were able to ambulate prior to discharge. In their series, Stern and Godstein[57] reported, out of 29 intertrochanteric fractures stabilized using a leinbach proximal femoral replacement,86% of patients were ambulatory with in first week of surgery.

At the end of the study period, 6 patients(10%) had full range(211^0-300^0) of movements. 9 patients(65%) had good range(161^0-210^0) of movements. 3patients had fair rang(101^0-160^0)2 patients showed poor range(61^0-100^0) of movements even at the end 6 months. Gross restriction was not seen in any of the patients.

In the present study slight limping was noted in 80% of the patients and 20% of the patients had moderate limping at the end of 6 months. 30% of the patients did not use any support for walking. 45% of them used cane occasionally and 10% used cane most of the time. 15%patients not able to walk without crutch.5patients used cane before their fracture and they continued to use cane even after surgery.

75% of the patients were able to walk for longer time without any difficulty at the end of 6 months. Only one patient was walking indoors only. Out of 20 patients 80% used public transport without difficulty at the end of 6 months.20%of patient are not able to use public transport.

In a study by sanchetti et al[27],out 35 patients 23 patients were able to walk without support 10 patients had a limp and used a walker and 1 was wheel chair bound. A total of 22 patients had abductor lurch at 3 months follow up.

Limb length discrepancy:

In the present study 35% of the patients had no limb length discrepancy. 55% of the patients had shortening of their limbs varying from 0.5 to 2cm which was well compensated by giving a shoe raise.2 patients(10%) had lengthening within 1cm.Average limb length discrepancy in this study was 0.9 c.m.

Leg – length discrepancy was noted in 5 patients among 54 elderly patients who has undergone bipolar arthroplasty for intertrochanteric fracture, in a article in Springer link, journal of international orthopedics (2004) [46]. In another study done by SKS Marya et al, (2008) [45], 19 patients on whom surgery was done, restoration of leg length to within 5 mm was observed during follow up. Sancheti et al[27], in their study observed an average shortening of 1.1 c.m in 10 out of 35 patients undergone cemented bipolar arthroplasty for intertrochanteric fractures.

Complications:

In our series 70% of the patients in the present study did not have any complications. 15% of them had knee stiffness 10% had infection and 5% had nerve palsy respectively.One patient had superficial infection which showed positive for staphylococcus epidermidis in culture and sensitivity. The patient was treated with parentral antibiotics. We didn’t come across other complications like dislocations,periprosthetic fractures in our series.One patient had foot drop in the immediate post operative period, he was managed conservatively with foot drop stop splint and physiotherapy and over a period of 3 months, he recovered fully.

No complications and pain was observed in 19 patients who had undergone hemiathroplasty in a study done by SKS. Marya et al,(2008)[45].Haentjens et al[58] in their series reported 3% dislocation in bipolar replacement groups compared with 45% in total hip replacement groups.

Harris Hip Score:

Rodop et al[23], in a study of primary bipolar prosthesis for unstable intertrochanteric fractures in 37 elderly patients obtained 17 excellent (45%) and14 good (37%) results according to the harris hip scoring system.In a study by sancheti et al[27]. a total of 25 out of 35 had a good to excellent (71%) results.

Similarly in an article given in Springer link journal of international orthopedics (2004) [46] among 54 elderly patients on whom surgery was done, Harris hip score was excellent in 17% and good in 14% of cases. More or less similar findings have been observed in the study done by Yin Q et al, (2008) [47] among 85 pts over all Harris hip score were 84% (excellent in 16%, good in 56%, fair in 12% and poor in 16%).

Haentjen et al[58]. reported on a series of 100 patients,75 years of age or older,who were treated with either a cemented bipolar arthroplasty(91patients) or total hip arthroplasty(9patients) for an unstable intertrochanteric or subtrochanteric fractures.Good to exellent results were noted in78% of patients.

In our study Out of 20 patients 6 patients (30%) showed excellent(90-100), 6 patients (30%)showed good(89-80) Harris Hip score. 5 patients(25%)showed fair(79-70) and only 3 patients (15%) showed poor(<70)Harris hip score. Mean Harris Hip score was 81.25 points.It shows the good functional outcome of cemented bipolar arthroplasty in elderly patients with intertrochanteric fractures in our study.

CONCLUSION

- The treatment of unstable intertrochanteric fractures with cemented bipolar arthroplasty in elderly individuals markedly reduces the morbidity due to prolonged bed rest like pressure sore, pulmonary infection and atlectasis.

- It has definitive advantages of early mobilization, relatively predictable pain relief and return to nearnormal activities of daily living.
- In our study unstable intertrochanteric fractures in elderly patients treated with Cemented Bipolar Athroplasty has given encouraging results in majority of our patients.

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PROFORMA

NAME :	I.P.NO :
AGE & SEX :	D. O.A :
OCCUPATION :	D.O.S :
ADDRESS :	D.O.D :

COMPLAINTS :

1. History of the Injury:

(i) Date and time of Injury :

(ii) Place of accident :

(iii) Nature of violence

a. Direct / Indirect :

b. Road Traffic Accident :

c. Fall from height :

d. Assault :

e. Others :

(iv) Immediate treatment :

(v) History of massage :

(vi) Any comorbid condition :

(2) General physical Examination

(i) Built & Nourishment :

(ii) Signs : Pallor/Jaundice/clubbing/cyanosis

(iii) Lymphadenopathy : General/ Local

(iv) Pulse Rate :

(v) Blood Pressure :

(3) Systemic Examination

(i) CVS (ii) RS (iii) P/A (iv)CNS

(v) Other joint functions

(4) Local Examination : Right Lower Limb / Left Lower Limb

(i) **Inspection**

(a) External Injury :

(b) Attitude / Deformity :

(c) Abnormal swelling :

(d) Shortening :

(e) Skin : Edema ☐ Ecchymosis ☐ Abrasion ☐

(ii) **Palpation**

(a) Local tenderness :

(b) Bony irregularities :

(c) Abnormal movements :

(d) Crepitus :

(e) Pain elicited by manipulation :

(f) Transmitted movements :

(iii) **Measurements** : Shortening : Apparent ☐ Real ☐

(5) Other Bony Injuries :

(6) Associated Injuries

(a) Neurological Injuries :

(b) Vascular Injuries :

(7) Investigations

(i) Urine : Albumin :

Sugar :

(ii) Blood :

Heamoglobin :

Sugar :

Urea :

Grouping&typing :

(iii) ECG :

(iv) Xray pelvis with both Hip :

Anteroposterior :

(v) Boyd & Griffin Type :

(vi) X-ray chest PA :

(vii) Others :

(8) preoperative Treatment : (i) Skeletal traction

(ii) Skin traction

(iii) Blood transfusion

(9) Surgical management

(i) Time interval between injury and surgery:

(ii) Anaesthesia :

(iii) Position :

(iv) Operative findings

(v) **Implant** : **Cemented Bipolar prosthesis**

Size:

(vi) Medial cortex reconstruction :

(vii) Trochanter Reconstruction : a.TBW :

b.Cancellous screw :

(viii) Any complication encountered during surgery :

(ix) duration of surgery :

(xi) Blood loss during surgery :

(10) Post Operative Treatment

(i) Antibiotics and Analgesics :

(ii) Transfusion : Fluids :

Blood :

(iii) Post OP Limb position :

(iv) deep vein thrombosis prophylaxis:

(v) Immobilization : applied / not applied

(v) Check X-ray Date :

(vi) Date of suture removal :

(vii) Active hip&knee mobilization :

(viii) Partial weight bearing :

(ix) Full weight bearing :

(11) Complications

(i) Intra operative : a. Shock :

b.other complications :

(ii) Post operative :

a. Bleeding :

b. Wound infection / Dehiscence :

c. Sepsis :

d. Swelling :

e. Nerve injury :

f. Limb length discrepancy :

g. Deep vein thrombosis :

h. Stiffness :

i. Dislocation :

j. Periprosthetic fracture :

(iii) Late complications :

a. Wound infection :

b. Knee stiffness :

c. Prosthetic loosening:

Follow up : Harris Hip score :

1. 1 month :
2. 6 months :
3. Final :